ELG 5124 Virtual Environments

Fall 2003, Tu & Th 11:30-13:00, SITE 2-060

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Marking system: Assignments ...   10%
                       Project report ...   50%
                       Final exam. ...   40%

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Calendar description
Basic concepts. Virtual worlds. Hardware and software support. World modeling. Geometric modeling. Light modeling. Kinematic and dynamic models. Other physical modeling modalities. Multi sensor data fusion. Anthropomorphic avatars. Animation: modeling languages, scripts, real-time computer architectures. VE interfaces. Case studies.

Rationale
Virtual environments represent a rapidly emerging technology, which can be defined as "a way for humans to visualize, manipulate and interact with computers and extremely complex data." Computer generated visual, auditory or other sensual outputs to the human user can be mixed with the sensor-based models of the real world to generate a "virtual world/environment" within the computer. This world may be a CAD model, a scientific simulation, or a view into a database. The user can interact with the world and directly manipulate objects within the virtual environment. Some worlds are animated by other processes, physical simulations, or simple animation scripts. This technology has already found promising applications in the industry, communications, telerobotics, medicine, and entertainment.

Detailed course outline

Virtual Environments (VE) - basic concepts.
Historic development. Basic concepts: viewpoint, navigation, manipulation, and immersion in VE.   Multidimensional virtual worlds. Hardware and software for VEs. Application examples in industry, multimedia communications, medicine, entertainment.

World Modeling.
World coordinates. Geometric modeling: viewing in 3D, representing curves and surfaces, solid modeling, the quest for visual realism, image manipulation and storage. Kinematic modeling: object position, articulated structures, collision detection. Dynamic behaviour. Object interaction. Other physical modeling modalities: electromagnetic and thermal fields. Multi-parameter world models. Multisensor data fusion.

Anthropomorphic Avatars.
Computer facial modeling and animation, human body modeling and animation.

Animation.

Animation in VE. Multimedia synchronization problems. Modeling languages: viewers, editors, and specification. Event scheduling. Distributed VEs. Animation scripts. Computer architectures for real-time applications.

VE interfaces.

User-interaction modes: window on world, fish tank, video mapping, immersive systems, telepresence, augmented reality. Visual, position, tactile, force, and sound interfaces (sensors and feedback) for VE interfacing with the real world and human users.

Case studies.

Multimedia communications and videotelephony. Virtual prototyping environment for electronic design automation. Telerobotic control of a mobile robot for hazardous environments.

References

[1] G. Burdea and Ph. Coiffet, ***Virtual Reality Technology***, (second edition with CD-ROM), Wiley, New Jersey, 2003, (ISBN 0471360899).

[2] Jerry Isdale, "What Is Virtual Reality? A Web-Based Introduction," Version 4 – Draft 1, http://www.isdale.com/jerry/VR/WhatIsVR.html, September, 1998

[3] R. Carey and G. Bell, ***The Annotated VRML 2.0 Reference Manual***, Addisson-Wesley Developers Press, 1997

Related websites:

http://www.web3d.org/fs_specifications.htm - *VRML & Extensible 3D (X3D) International Draft Standards Consortium*

http://web3d.about.com/ - *3D Graphics/Virtual Reality*

http://www.isdale.com/jerry/VR/index.html - Jerry Isdale's VR Page

http://www.cse.dmu.ac.uk/~cph/vrstuff.html - *Chris Hand's VR Stuff*

http://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-838Algorithms-for-Computer-AnimationFall2002/CourseHome/index.htm - MIT OpenCourseWare 6.838 Algorithms for Computer Animation